Ginseng

ATLANTIC PROVINCES VEGETABLE CROPS GUIDE TO PEST MANAGEMENT 2002 - 2003

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Introduction

American Ginseng (*Panax quinquefolius L.*) belongs to the Araliaceae (the Aralia or ginseng) family. It is native to eastern Canada and the United States (from Quebec to Louisiana) and is closely related to other species of ginseng growing in China, Korea and Russia. A dwarf ginseng (*Panax trifolius*), called groundnut, can be found growing in rich woodlands along flood plains of rivers in the Maritimes. The root is small, making harvest from the wild uneconomical.

The name "*Panax*" comes from the Greek "panakeia" for all-healing, alluding to the reputed medicinal value of ginseng which has been used extensively in oriental countries as a traditional medicine. The name *quinquefolius* is in reference to the five leaflets per leaf found on a mature plant.

American Ginseng was first discovered growing wild in Canada by Jesuit missionaries in 1715. The wild ginseng was harvested and exported to the Far East. At one time, ginseng trade rivalled the fur trade. Cultivation of ginseng started in the early 19th century in areas around Waterford, Ontario and in Wisconsin. Wild ginseng is now an endangered species and is closely regulated in indigenous areas of Canada and the U.S.A.

Botanically, American ginseng is a fleshy rooted, herbaceous perennial with

whorled leaves. It generally takes 3 to 5 years before harvest in field culture under shade cloth. The underground rhizome has a scar added each year so the age of roots can be determined. The root is contractile; that is, it shrinks vertically each season. This allows the lengthening rhizome to remain underground. It also makes the root wrinkled which is a desirable feature in the marketplace. The edible part of the plant is the fleshy root which is usually cleaned and dried, though it can be eaten as a fresh vegetable.

Ginseng is a shade loving herb and grows naturally under conditions of 70 to 80% shade. It also requires free circulation of air under a canopy of hardwood forest or artificial shade. American Ginseng will grow only in temperate areas of the world, mainly North America and Asia, where cold and/or winter gives a dormant period (100 days at a temperature of 0 to 10°C or lower).

Each season one additional leaf is produced per plant. This leaf has 3 leaflets in the first year. The root is less than 1 gram fresh weight after the first growing season. The second year's growth will produce a plant with 1 or 2 leaves and 3 to 5 leaflets on each leaf. Some seed may be produced. In the third year the plant will have 2 or 3 leaves and seed is produced. The fourth year of growth will produce a plant of four leaves with high yields of seed. The leaf number seldom exceeds four. The root at four years should have a fresh weight of 60 grams. The dried weight is 30% of the fresh weight. Mature roots are 7 to 13 cm long and are usually forked.

Flower heads develop on a single stalk as an umbel with 30 to 40 blossoms. Flowering occurs over a period of 3 to 4 weeks in mid summer. Flowers are self fertile but may be assisted by bees and cross pollination does occur. The red berries, when ripe, contain two seeds each.

Seed that has been stratified for 16 to 22 months is planted in October and mulched with straw. Germination occurs in the spring. Frost will kill leaf tissue so some locations may not be suitable, e.g. frost prone southern exposures with sandy soil.

Adequate moisture is necessary for good yields and quality but excessive moisture will easily cause disease. Irrigation may be necessary, especially on sandy soil. Dry sandy soil may produce roots that are long and slender and there may be hard "flinty" roots which are of lower yield and quality.

Deep, well drained and well aerated soil, free from stones, ideally over one metre in depth, is necessary for the development of high yields of quality roots. The best vegetable soils in the Atlantic area are preferred for this crop. Sandy soils can be used but irrigation should then be considered. The crop is planted on beds with 1.8 metre centers. Each bed is crowned to give better drainage and a good seed bed.

Seed can be harvested in the 3rd year with an expected yield of 100 kg of seed per hectare. In the 4th year or beyond, yield should be 300 kg of seed per hectare. Root harvest preferably does not begin before the fourth year although

three year old roots can be harvested if necessary. Gardens can be left to year five or beyond if justified by price. Harvest is during October and yields of dry root should be over 2500 kg per hectare (2200 lb of fresh root per acre). The roots are washed and graded prior to drying. Soils high in clay may produce roots which are stained. In the short term, this means marketing problems; in the long term, it may be a positive factor if higher levels of potency are determined.

There are over 80 acres of protected ginseng planted in the Atlantic Region, and a total of 8000 acres in Canada. There is also much interest in woods-grown production. Examples of value-added products are teas, roots and candy. The Far East, through Hong Kong brokers, has been the major market. Additional market volume depends on economic growth in Asia and the development of new markets for the processed product. Currently 85% of the North American root is sold in the Asian market.

The future market depends on export to other areas of North America, Europe and the Far East. There may be some specialty market possible for the fresh root.

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Seed Treatment - Generally when seed is purchased it is stratified and ready for a chemical seed treatment. Stratification means that the seed embryo has been matured and this process takes 18 to 22 months. The seed must be kept moist during this process until they are planted. The seed is dried just enough to get it through the planter. Seed can be temporarily stored in a refrigerator prior to planting.

Seeding/Planting - Fall seeding is usually done in North America from September to November. The seed is sown on raised beds 1 to 1.2 m wide and 1.8 m center to center. This allows space for mechanized seeding, spraying and harvesting. The seed should be planted into moist soil or, if the soil is dry, immediately irrigated after seeding. Seed is sown in rows 10 cm apart at a rate of 20 seeds per metre or 110 kg per hectare (approximately 8000 seed per 500 g). Seed should have 70% germination and good seed lots should have over 85%. The seeding depth is 1.3 to 2.5 cm. The plant density should be about 150 plants per square metre. Lower populations of healthy plants may still give good yields.

Field Rotation - Replanting on the same site is discouraged because of disease problems and low yields. More research is needed on this topic so a workable rotation can be developed.

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Prior to seeding, fumigation of the soil may be necessary on certain fields to reduce harmful diseases, nematode and weed problems.

Mulch - After seeding the raised beds should be mulched with oat or barley straw in a 10 to 12 cm thick layer. Mulching materials conserve moisture in the soil which is important for seed germination in the spring. Half as much straw is

added in the fall of the second year. Roots freeze at approximately -10°C and so mulch acts to protect roots from cold injury due to fluctuating temperatures and dehydration during the winter months. In extremely sandy soil, irrigation may be necessary in some seasons.

Shading - For healthy growth, 70 to 80% shade is necessary. Artificial shade can be provided by wood lathe or woven black polypropylene. If artificial shading is used, run the beds east to west so the shading can go north to south providing alternating sun and shade to the plants. The direction of prevailing winds must be considered for air circulation. Also, the surface water drainage must be considered. The shading must be removed or winterized just before first snowfall, as snow, hail or high winds may cause damage to shading systems.

Wood shade panels are approximately 1.2 m x 4.3 m and are constructed from three 1" x 3" x 14' boards with 1" x 3/8" x 48" lathes stapled to them. Only 3.6 m of this length is covered with lathe. There are 900 panels per acre tied down to stop wind from lifting them off. These panels sit on 2" x 6" attached to the top of posts which are placed 3.6 m x 3.6 m.

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In the wild, American ginseng is found on high pH soils that are relatively rich in nutrients and organic matter. Little research has been done in the Atlantic area but work at the NSAC has shown the crop does not respond well to NPK fertilization. Generally, high organic matter levels prior to planting are desirable to improve soil structure.

Lime - Limestone should be applied to maintain a soil pH of 6.5 to 6.8. Gypsum may be used on sandy soils where calcium levels are low and the pH is quite high. This will increase the soil calcium and sulfur levels.

Nitrogen - This nutrient may be supplied in the form of manure, fertilized green manures or sod before the crop is seeded. The rate of nitrogen required increases with the age of the crop in years; e.g. 40, 50, 60 and 80 kg N/ha is used for 1, 2, 3 and 4 year old gardens respectively. Sidedressing should be carried out during the dormant season at least 2 weeks before plants emerge to avoid fertilizer burn. Excessive nitrogen may cause lush growth and more disease problems.

Phosphorus - This nutrient is relatively immobile in the soil so should be added prior to planting and incorporated into the upper part of the crop rooting zone. Phosphorus is important in vigorous plant growth and disease resistance.

Potassium - Ginseng is not responsive to potash in most North American trials, though it is necessary for a root crop. Potash is moderately mobile in the soil and can be put on as a topdressing, especially in the 3rd and 4th years as roots begin to size.

Other Nutrients - Magnesium deficiency may occur where dolomitic limestone has not been used. Sulfur can be deficient especially in sandy soils. The addition

of gypsum may be beneficial since it supplies both calcium and sulfur. Boron is deficient in most Atlantic soils especially where the pH is over 6.0. It may be applied in the dormant period as a spray on the straw mulch (it is also a mobile nutrient in the soil). Foliar applications of boron may be made but care has to be taken as injury may occur if it is too concentrated or applied during the heat of the day. Zinc is not usually a problem but could be applied during the planting year in granular fertilizer.

Application Method - Broadcast and incorporate most fertilizers before planting. Some nitrogen, sulfur, boron, potash and calcium can be applied as the crop matures. Application would be mainly in the dormant period before the crop has started to grow in the spring.

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Insects

Ginseng has very few insect pests. However, there are a few that can occasionally cause problems. Some that may cause problems are the following.

Cutworms

***Characteristics*:** Cutworms are the larvae of noctuid moths. There are several species that are common pests of various vegetable crops. The caterpillars vary in colour but are usually brown or greyish. They are smooth skinned, and curl up when disturbed. Cutworms vary in size, but reach 35 to 45 mm in length when fully grown. They feed below or at ground level, and are active at night. A few species feed higher on the plant and are referred to as climbing cutworms. Plants that have been attacked by cutworms have their stems severed at or just below the soil surface.

Control: Cutworms have not been reported as a problem in the Atlantic region, but the potential for damage still exists. There are no chemicals registered for cutworms on ginseng. Fallowing the site the year before planting will reduce the number of weeds that may attract cutworms into the area. It may also be possible to control cutworms in crops and areas adjacent to the ginseng garden.

Wireworms

Characteristics: Wireworms are the larvae of click beetles. Wireworms are slender, wormlike and yellowish to amber in colour. They have three pairs of legs, on the segments just behind the head, and do not curl up when disturbed. They range in length from 5 to 25 mm. They feed on roots, mainly of grasses but also on a wide variety of other plants. The larval stage of wireworms lasts from 3 to 5 years. They feed on roots near the surface of the soil during the growing season. In the fall they move deep into the soil to spend the winter.

Control: There are no chemicals registered for wireworm control in ginseng. Wireworms are most likely to be a problem if they are present in the soil before

the crop is planted. Fallowing the site the year prior to planting will reduce wireworm numbers. Planting a cover crop of wheat treated with lindane, prior to seeding, will reduce the number of wireworms.

Slugs

Characteristics: Slugs are Molluscs, and are similar to snails but lack an external shell. They are nocturnal, and feed by rasping the surface of leaves and seedlings. They leave a trail of mucus, which may be seen on leaf surfaces, and is an indicator of slug activity. Slugs thrive in wet conditions. The straw mulch used in ginseng production is ideal for slugs. They may be especially prevalent along garden borders.

Control: Keep weeds and vegetation controlled along the borders of gardens. Slug bait, containing metaldehyde, can be used along the edges of gardens and between plants. Do not allow the pellets to fall on the foliage. Metaldehyde is attractive to dogs and cats. They must be prevented from entering treated areas.

Vertebrate Pests

Characteristics: Field mice or voles may damage roots and will also feed on ginseng seeds. They prefer areas with a good cover of grasses and weeds. The straw mulch used in ginseng production offers a good hiding place for mice.

Control: Keep area around the perimeter of the garden free of tall grasses and weeds. Weatherproofed poison baits can be used to reduce mouse populations. Care must be taken to prevent pets and children from contacting the baits.

Diseases

Plant diseases can be limiting factors in ginseng production. There are a number of fungal organisms capable of severely damaging ginseng.

General Disease Management

- choose sites with good soil drainage and a slight slope
- choose sites with adequate air movement that are not extremely windy
- choose smaller garden sizes
- use clean, washed sand with low silt content for stratifying seed
- prevent damping off by using moderate seeding rates
- spread straw evenly
- practice good sanitation for people and equipment moving between gardens
- monitor fields to detect diseases or pests early
- maintain good cultural practices for plant health, eg. good weed control, adequate nutrition

***Alternaria* Stem and Leaf Blight**

Characteristics - Leaf lesions are generally circular in shape and typically have

yellow to green yellow halos. Stem lesions are elongated, reddish to dark brown in color and often appear to originate where the stem comes in contact with straw mulch. *Alternaria* is first seen on the leaves in early to mid summer, especially in warm, rainy or humid weather. Stem cankers appear earlier in the spring, before the foliar lesions are formed. Often plants affected by *Alternaria* blight occur in patches, suggesting that it spreads from an initial focus.

Control - Remove affected plants from the garden. Apply registered fungicides as necessary and improve air circulation. Ensure good spray penetration and coverage. Avoid excessive nitrogen applications.

Damping Off

Damping off is caused by a range of organisms that are common in soils or plant residue. These organisms can cause seed decay and seedling root rots. Root damage may be extensive in first year gardens.

Characteristics - Plants develop water soaked or brown rot on the roots. In many instances damping off will lead to the death of the plant, but in other plants lesser amounts of damage may occur.

Control - Gardens should be situated on well drained soils.

***Phytophthora* Root Rot**

Phytophthora root rot can cause severe epidemics. All parts of the plant are affected and the spread through the garden is rapid.

Characteristics - Leaf blight symptoms of the disease are water soaked, dark green lesions on the leaves. Leaflets of diseased plants collapse downward from the base of the petiole and the stems become hollow and brown.

Roots infected by *Phytophthora* have a light brown discoloration on the skin. The interior of the rotted root is creamy white with a soft texture. Squeezing infected roots by hand often causes the soft inner tissue to extrude like toothpaste from the tube. A foul odor is sometimes associated with the disease. The disease is favored by cool, wet, humid weather conditions.

Control - Avoid planting on infected soils or where ginseng has been grown before. Choose well drained soils and maintain high arched beds to improve drainage. Fungicides are available for control.

Other Diseases

There are a number of other important diseases of ginseng including rusty root, disappearing root and *Botrytis* blight. Refer to the references for further information.

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Usually harvest occurs in the fourth year during October. Roots weigh about 75 gms and are about 10 cm long. All the posts, cables, shade material and straw mulch are removed from the field. This allows the root harvester to function properly. The mulch and plant debris can be removed by hand or pushed off with a tractor and blade. Traditionally the root is dug and allowed to fall back on the ground. The speed of harvest should be slow so the roots are not crushed or broken as aesthetic quality is important.

The roots are picked by hand into tote boxes and taken to be washed. The digger may make a second or third pass to assure that all the roots have been recovered.

A drum washer may be used. The roots must be carefully cleaned without damaging the skin. Blemished roots result in lost value. Ginseng roots should not be allowed to sit in water.

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Fresh ginseng root can be refrigerated for up to 6 weeks before drying if capacity is not available. Cold storage allows harvesting to proceed and takes advantage of good harvesting conditions in the field.

Currently growers are using cold storage at 5 to 8ºC and 80% to 90% RH. Roots from smaller growers may be shipped to a drying facility.

Drying

Drying is critical for quality ginseng root. Heat damage or fungal development can occur from too short or too long a drying process. Roots should be sized and similar sizes dried together. A modified tobacco kiln dryer can be used for large volumes of ginseng.

The best temperature for drying is 38ºC with low humidity for 12 days. The optimum moisture content is 8% to 10%. A "snap and bite" test can show crispness and hardness of the root.

Dried roots are usually packed in cardboard barrels lined with plastic, holding 100 lbs of root each. Roots are usually graded on the farm.

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PEST	PESTICIDE (Formulation)	RATE Product	DAYS TO HARVEST	REMARKS
Weeds ▲ to Top				
Preplant Perennial Weeds including quackgrass	ROUNDUP 356 Sn	2.5 to 7.0 L/ha	-	Apply in the fall or spring prior to planting. Annual weed control programs will be necessary to control weeds germinating after planting. For quackgrass control apply to actively growing quackgrass when at least 4 new leaves are present. The low rate (2.5 L/ha) will provide a minimum of one season control, while higher rates (4.75 to 7 L/ha) will provide longer term control. The low rate of Roundup should be applied in 50 to 100 L/ha water. If higher water volumes are used add a suitable surfactant. Wait 72 hours before plowing under. Best control of quackgrass is obtained when these herbicides are applied in the fall.
	TOUCHDOWN 480	2.5 to 7.0 L/ha	-	
	GLYFOS	2.5 to 7.0 L/ha	-	
	ROUNDUP TRANSORB	2.5 to 7.0 L/ha	-	
Diseases ▲ to Top				
Root Rot	VORLEX PLUS	Follow Manufacturer's Directions	-	*Rhizoctonia, Fusarium, Phytophthora, Pythium* and *Cylindrocarpon* may cause seedling damping off and/or root rot. Avoid overcrowding and poorly drained soils.
	VORLEX CP		-	
	TELONE C -17		-	
	BUSAN		-	

	VAPAM 1020		-	
	QUINTOZENE 75 WP	9.0 kg/ha in 3415-4500 L water	-	Quintozene may be used to control *Rhizoctonia*, crown rot and damping off. Apply in a high volume spray only once per year prior to bud break. Do not apply within 24 months of anticipated harvest date. Do not plant any other root crop for a minimum of 1 year following ginseng harvest. See label precautions.
	RIDOMIL 2 G	31.25 kg/ha	9	Use a suitable granular spreader to spread granules evenly. One application is to be made in the spring just prior to the time plants begin to grow. Make a second application 6 weeks later and a third application 6 weeks after the second one. Do not make more than 3 applications per season.
	RIDOMIL 240 EC	1.3 L/ha	9	For damping off and root rot control apply prior to emergence of seedlings. Apply in a minimum of 2500 L of water per hectare. Do not apply to emerged foliage.
	ALIETTE 80 WDG	5.5 kg/ha	31	Apply a maximum of 5 applications per year. Use a minimum of 200 L of water per hectare.
Alternaira Blight	DITHANE 75 DG	4.4 kg/ha in 2000 L water	30	Avoid applications in temperatures over 30C. Apply at first sign of disease. Do not use Rovral more than 3 times per season and alternate with other fungicides.
	PENNCOZEB 75 DF	4.4 kg/ha in 2000 L water	30	
	DITHANE M-45 80 WP	4.4 kg/ha in 2000 L water	30	
	ROVRAL 50 WP	1.1 kg/ha in 2000 L water	30	
	DYRENE 50 WP	4.4 kg/ha in 2000 L water	30	
	BRAVO 500 F	2.3 L/ha	14	Bravo will also control *Botrytis*. Start applications when disease threatens and repeat at 7 to 10 day intervals. Do not apply more than 6 times per season.